

Discovering the Sarasvati River: From 1855 to 2014

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Praised in the Rig-Veda as a 'mighty' river flowing 'from the mountain to the sea' and listed in the Nadi Stuti hymn (10.75) between the Yamuna and the Sutlej, the Sarasvati is reported a few centuries later, in several Brahmanas and the Mahabharata (whose great war is waged in the Kurukshetra region watered by the river and its tributaries), to be disappearing in the desert at a point called *Vinashana*, a highly revered pilgrimage site. The river went on dwindling down, eventually becoming 'mythical', relocated at the confluence between Ganga and Yamuna as an 'invisible' river—a device that effectively preserved continuity of worship of the river-goddess, since from Vedic times Sarasvati had been turned into a goddess of inspiration and speech (Danino, 2010).

One of the persistent 'stories' in our media and on countless websites is that the Sarasvati was 'rediscovered' by satellite imagery in the 1970s. As it happens, the date is wrong by over two centuries. As early as in 1760, a map from *The Library Atlas* (Bryce, Collier & Schmitz) showed a small stream, 'Soorsuty', joining the 'Guggur' in Punjab (Fig. 1). In 1778, James Rennell, a noted British geographer and cartographer, included in his *Memoir of a Map of Hindoostan or the Mogul Empire* the most detailed map of India then available; it showed 'Sursooty' meeting the 'Caggar' or 'Kenker'. The Ghaggar, as it is spelt today, is a seasonal river flowing down from the Shivalik hills; one of its tributaries is indeed a small seasonal stream called 'Sarsuti'. During strong monsoons (as in 2010), the Ghaggar still manages to flow well into Punjab; there is historical evidence that in the 19th century, it occasionally reached Anupgarh, close to the present Indo–Pakistan border (at which point the river's name changes to 'Hakra').



Fig. 1 The Sarasvati and the Ghaggar marked by the two arrows in this detail of a 1760 British map. (Courtesy Prof. Frances Pritchett of Columbia University, www.columbia.edu/itc/mealac/pritchett/00maplinks/colonial/india1760/india1760.html).

In the next century, British topographers—among them James Tod (in the 1810s), Major Colvin (in 1833) and Major F. Mackeson (in 1844)—surveyed the bed of the Ghaggar and found it far wider than the paltry waters it carried during monsoons would have required. Those early maps and reports soon reached the noted French geographer Louis Vivien de Saint-Martin (Fig. 2), who noticed the corrupt spelling of Sarasvati as well as the Ghaggar's location between the Yamuna and the Sutlej, as indicated in the Rig-Veda; combining physical and literary evidences, he was the first scholar to propose, in 1855, that the Ghaggar-Sarasvati system was the relic of the Vedic Sarasvati:

The trace of the ancient riverbed was recently found, still quite recognizable, and was followed far to the west. [This discovery] confirmed the correctness of the tradition (Vivien de Saint-Martin, 1858: 23).



Fig. 2. Louis Vivien de Saint-Martin (end of nineteenth century, courtesy Bibliothèque Nationale de France).

In the next few decades, nearly all Indologists, from H.H. Wilson and F. Max Müller to M. Monier-Williams, A.A. Macdonell, A.B. Keith or F.E. Pargiter, and more recently L. Renou, A.L. Basham or Jan Gonda, accepted Vivien de Saint-Martin's thesis (Danino, 2010). Geologists such as R.D. Oldham (1886) joined in, followed by geographers such as Shamsul Islam Siddiqi (1944) or Herbert Wilhelmy (1969).

This broad scholarly consensus was naturally reflected in nearly all British maps of the nineteenth century (Figs 3 & 4). Fig. 4 is a detail of a map in Alexander Cunningham's monumental *Ancient Geography of India*, in which he combined data from ancient Indian and Greek texts with the testimonies of Chinese pilgrims to India. The same year, 1871, Cunningham was nominated first director general of the ten-year-old Archaeological Survey of India. And it is indeed the discipline of archaeology that will give, seventy years later, an unexpected twist to the saga of the lost river.

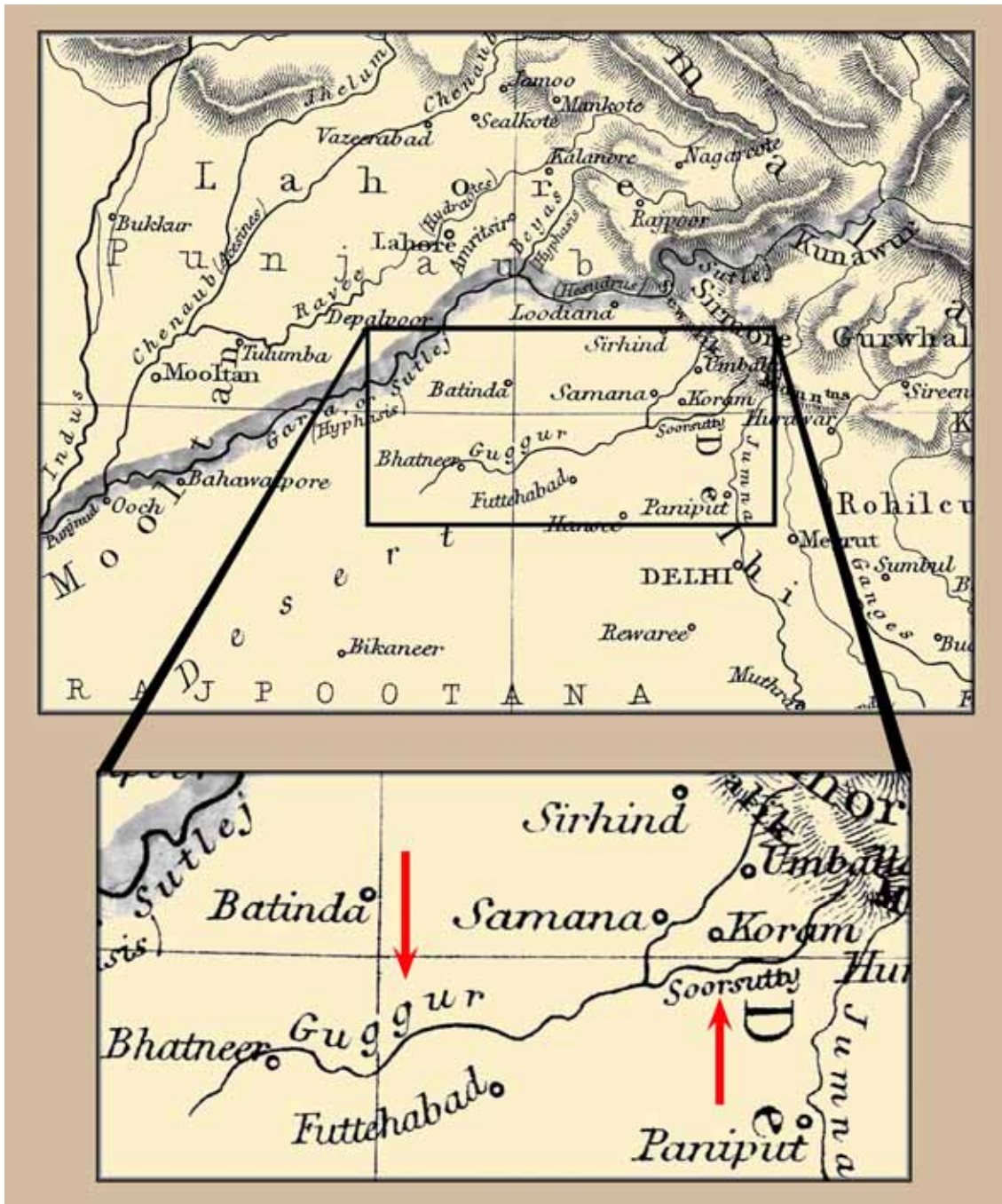


Fig. 3. Detail from a British map of India (from Henry Beveridge, *A Comprehensive History of India, Civil, Military, and Social*, Blackie & Son, London, 1862).

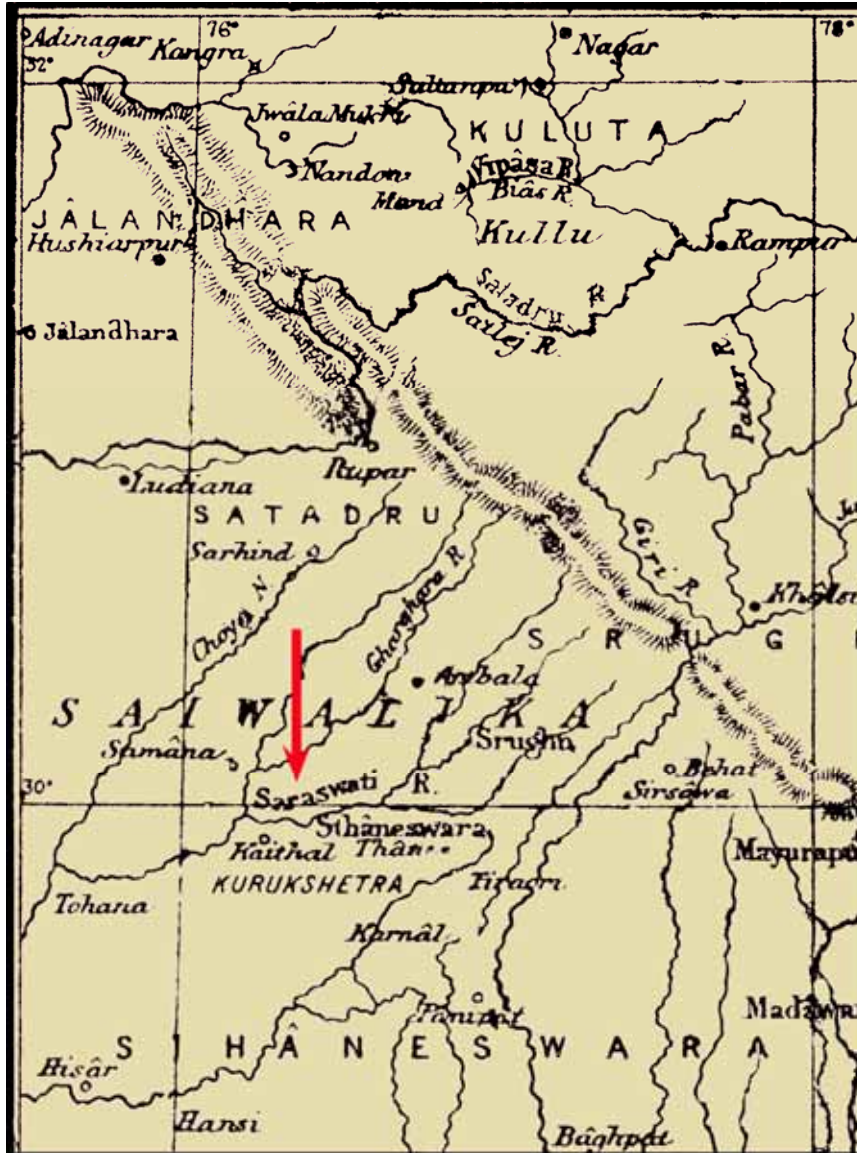


Fig. 4. Detail of a map showing the Sarasvati and neighbouring rivers (from Cunningham, 1871).

The Sarasvati and the Indus Civilization

The riddle of the Sarasvati would have been regarded as solved long ago if archaeology had not sprung a major surprise by redefining its role in antiquity. In the early 1920s, the Bronze Age cities of Harappa and Mohenjo-daro came to light, soon followed by more settlements of the same culture in the Indus Valley and Baluchistan. In 1941, the intrepid explorer and Sanskritist Marc Aurel Stein (Fig. 5) conducted at the age of 78 an expedition in the then Bikaner and Bahawalpur states; the former is now part of

northern Rajasthan, while the latter, today's Cholistan, is an arid region of Pakistan and technically part of the Thar Desert.

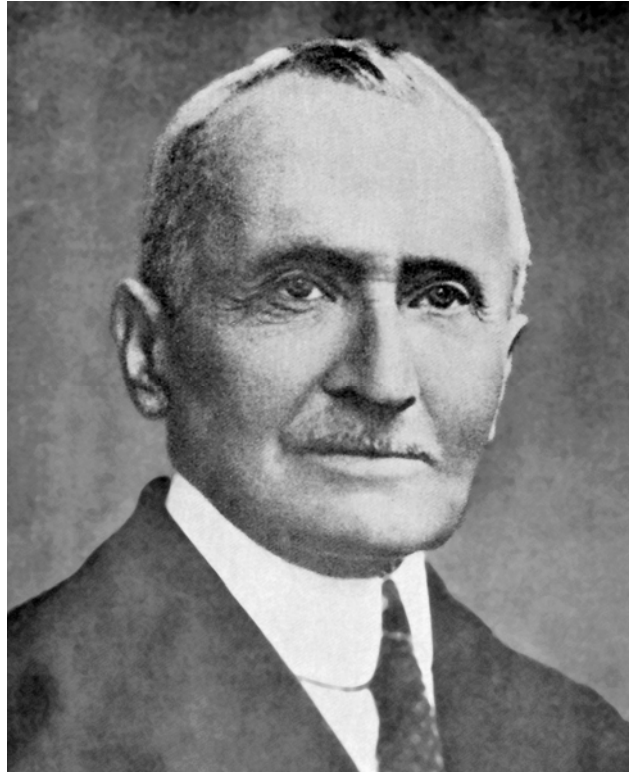


Fig. 5. Marc Aurel Stein (courtesy Archaeological Survey of India).

Stein was keen to find out whether the Harappan civilization extended to this region anciently watered by the Sarasvati—for he was among those who had accepted the identification between the Vedic river and the Ghaggar (which continues into Cholistan under the name of 'Hakra'), as an early paper of his makes quite clear (Stein, 1917). The region had long been known to be dotted with numerous ruined settlements, and, crisscrossing it on horse and camel back, Stein recognized Harappan culture in several of them (Stein, 1942, 1989): apart from similar pottery types, some of the pottery sherds displayed 'incised characters which appear on many inscribed seals from Mohenjo-daro and Harappa'. The Ghaggar-Hakra, in Stein's opinion, was home to 'very numerous prehistoric mounds' (Stein 1942: 180)—that is, going back to the Harappan age.



Fig. 6. A view of Kalibangan's mounds from the Ghaggar's bed (photo taken during A. Ghosh's expedition of 1950, courtesy Archaeological Survey of India).

Indeed, in the following decades, further explorations (Fig. 6) took place both in India and Pakistan: in 1951, Amalananda Ghosh identified Harappan culture at Kalibangan and several other sites further upstream; among his followers are Katy F. Dalal, Suraj Bhan, Jagat Pati Joshi, M. Rafique Mughal, R.S. Bisht.... In Cholistan, M. Rafique Mughal identified 363 new sites in 1974, 171 of which belonged to the Mature (or urban) Harappan phase (2600–1900 BCE). All these surveys put together established that the Sarasvati basin was home to at least 360 sites of the Mature—almost a third of the nearly 1,200 known such sites in the totality of the Harappan sphere. Among the larger Harappan cities found in the Ghaggar-Hakra basin are Bhirrana, Rakhigarhi, Kunal or Banawali (all in Haryana), Kalibangan (Rajasthan) or Ganweriwala (Cholistan) (Fig. 7 and Table 1; recent surveys by Vivek Dangi, Narender Parmar, Parveen Kumar and Raj Pal in Haryana, Punjab and northern Rajasthan have added a few dozens of sites since this table was prepared).

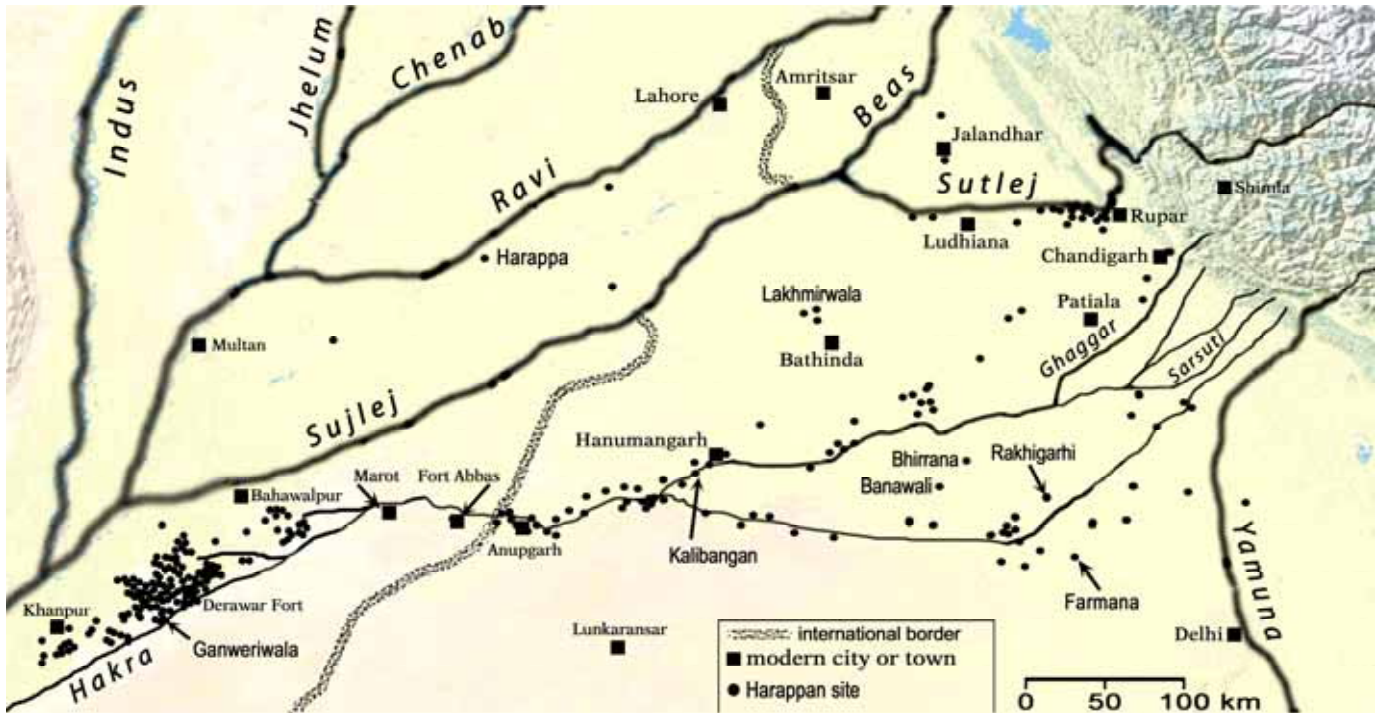


Fig. 7. Mature Harappan sites in the Sarasvati basin (map by Michel Danino).

Sarasvati Basin (east to west)	Early Harappan	Mature Harappan	Late Harappan	Total
Haryana	558	114	1168	1840
Indian Punjab	24	41	160	225
Rajasthan	18	31	0	49
Cholistan (Pakistan)	40	174	50	264
Total	640	360	1378	2378

Table 1. Distribution of Harappan sites in the Sarasvati basin (Michel Danino, adapted from a list compiled by S.P. Gupta, with inputs from G. Possehl and M. Rafique Mughal).

Since the Sarasvati, it was now clear, had nurtured the ‘Indus’ civilization as much as had the Indus, a few archaeologists, beginning with S.P. Gupta in 1989, have proposed the broader term of ‘Indus–Sarasvati civilization’. (It does not, however, cover all Harappan sites, since Gujarat is also host to some 300 Mature Harappan sites, most of which cannot be said to be in the Sarasvati basin.) For reasons that will become clear in the next section, the term did not really catch on, but the Ghaggar-Hakra’s identity as

the Sarasvati's relic was accepted by most archaeologists after Stein, including the British M. Wheeler (1968), R. and B. Allchin (1997) and J. McIntosh (2002, 2008), the American G.L. Possehl (1999, 2002) and J.M. Kenoyer (1998), the French J.-M. Casal (1969), the Pakistani A.H. Dani (in Mughal 1997: 11, 12), the Indian A. Ghosh (1952), B.B. Lal (1997, 2002, 2009), S.P. Gupta (1996), V.N. Misra (1994) or Dilip Chakrabarti (2006, 2009).

The Sarasvati and the Aryan Issue

Despite the broad consensus, a few scholars such as Romila Thapar, Irfan Habib, Shereen Ratnagar, Suraj Bhan or the late R.S. Sharma started in the 1980s questioning this term and the identification between Ghaggar and Sarasvati. What prompted this rather late reaction? The pattern of settlements in the Sarasvati basin now revealed that in its central part—roughly southwest Haryana, southern Punjab and northern Rajasthan—most Harappan sites were abandoned sometime around 1900 BCE, a period coinciding with the end of the urban phase of the Indus civilization (Fig. 8). Clearly, the river system collapsed—which archaeologists now see as a contributing factor in the decline of the brilliant Indus civilization.

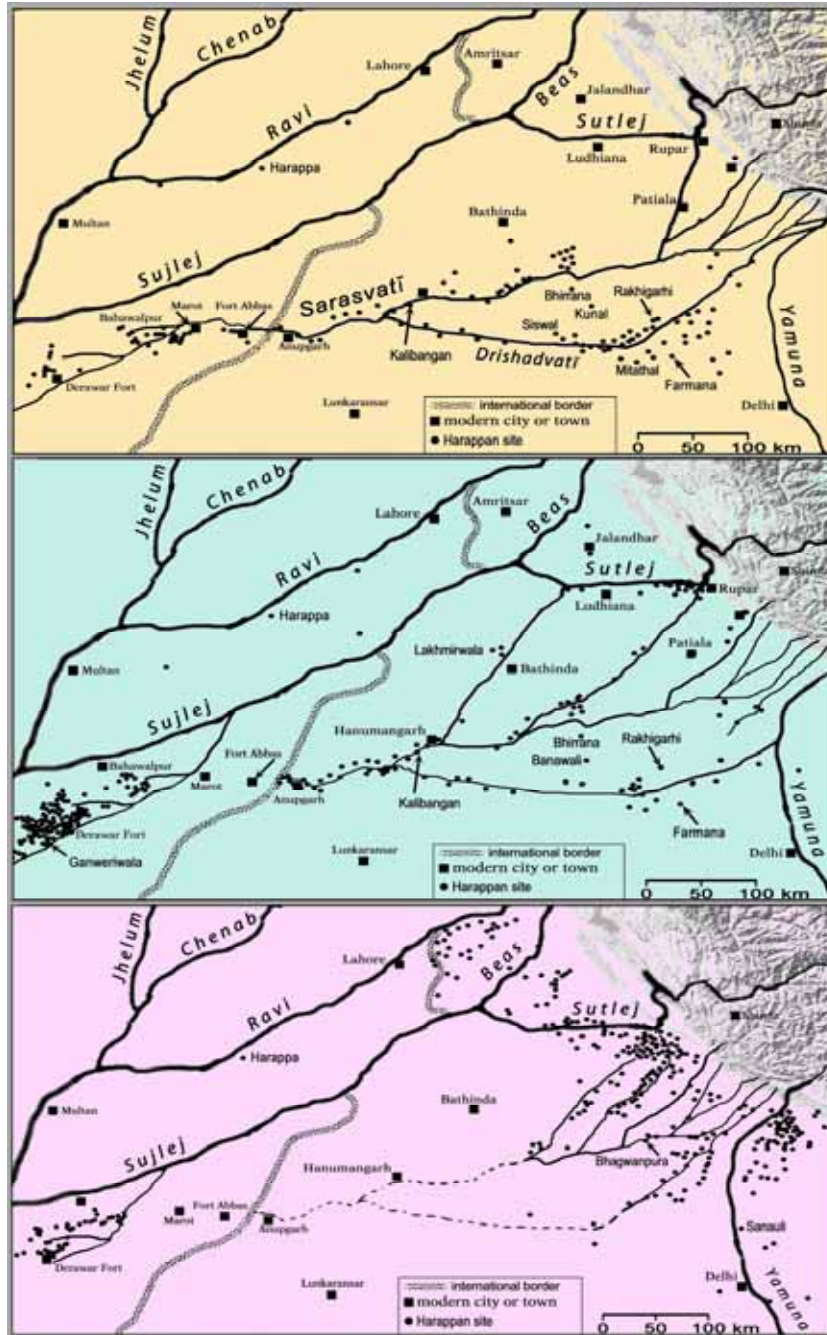


Fig. 8. Settlement pattern in the Sarasvati basin, clearly showing the abandonment of sites in the central basin from about 1900 BCE (maps by Michel Danino).

Why was this a problem? We must remember that the Sarasvati is lavishly praised, both as a river and a goddess, in the Rig-Veda, a collection of hymns which mainstream Indology says was composed by Indo-Aryans shortly after their migration to India around 1500 BCE. However, by that time, the Sarasvati had been reduced to a minor seasonal stream: how then could the said Aryans praise it as a ‘mighty river’, the

‘best of rivers’, ‘mother of waters’, etc.? There is a chronological impossibility. Either the hymns were composed much earlier, contradicting mainstream Indology, or, as the objectors now asserted, the Ghaggar-Hakra was not, after all, the Sarasvati extolled in the Rig-Veda.

While some of the objectors, such as Rajesh Kochhar (2000) tried to relocate the river in Afghanistan, others like Irfan Habib (2000–01) decided that the Sarasvati was not a particular river, but ‘the river in the abstract, the River Goddess’—in other words, a ‘mythical’ river. But such theses ran against both the Rig-Veda’s own testimony that the river flowed between the Yamuna and the Sutlej, and the realistic descriptions of the river’s disappearance in the sands of the desert in subsequent literature such as the Brahmanas or the Mahabharata, with Vinashana given great prominence among pilgrimage sites.

However, what should have remained a scholarly issue now turned into an ideological and often acrimonious battle: On the one hand, those who stuck to the identity between the Sarasvati and the Ghaggar-Hakra concluded that the composers of the Rig-Vedic hymns must have lived in the region during the 3rd millennium BCE at the latest—but as the only settlements known of that period were Harappan ones, they often held that the Harappans were among the Vedic people; cultural evidence such as a Harappan swastika, yogic postures, figurines in *namaste* and more was pressed into service to bridge the Harappan and the Vedic worlds (Danino, 2010; Lal, 2002). On the other hand, scholars who continued to swear by an Aryan immigration in the mid-2nd millennium BCE, and therefore a pre-Vedic Harappan civilization, accused the former of ‘chauvinism’, ‘jingoism’, ‘false patriotism’ or worse, concealing that dozens of Western scholars had, for a century and a half, accepted the same location and identity for the Sarasvati river—a deplorable instance of intellectual dishonesty.

This negationist attitude is all the more bizarre as some of the above objectors (e.g. Thapar, Ratnagar, Bhan) had quite happily accepted the identity between the Ghaggar and the Sarasvati before the date of the latter’s desiccation became clear in the 1980s (see Danino 2010 for details). Habib himself, in his much-circulated article of 2000, wrote, ‘Given the earlier natural conditions, the Desert River [Ghaggar-Hakra] could come down to the Bahawalpur Cholistan, fed by its own rain-fed Siwalik and

Terai tributaries.’ But from the Shivaliks to Cholistan is no less than 1000 km, a distance no puny or ‘mythical’ stream could have flowed.

Recent Research on the Sarasvati

Leaving aside the controversy, several scientific disciplines now have their say. Since the 1970s, satellite imagery has proved to be a very useful tool, although by itself it cannot date the numerous buried palaeochannels (ancient waterways) it has brought to light; anyone can today access websites such as Google Earth and view the well-marked bed of the Ghaggar, but this does not tell us when a perennial river last flowed through it, how large it was, and where it drew its waters from. Many satellite studies have been published (to mention only a few recent ones, Bhadra et al., 2009; Danino, 2010: 66–73; Gupta et al., 2011, Rajani & Rajawat, 2011) and I will not go over them again here.

I will instead focus on recent geology and river studies, several of which have thrown new light on the ancient river, though at times with contradictory findings. Thus, in a 2011 article published in *Science*, Andrew Lawler claimed that ‘the Ghaggar-Hakra was at most a modest seasonal stream ... from 2500 B.C.E. to 1900 B.C.E.’ (Lawler, 2011), that is, at the height of the Harappan civilization. This ran against the notion of a substantial and perennial Sarasvati flowing during mature Harappan times. Lawler referred to independent studies piloted by geologists Sanjeev Gupta, Peter Clift (both from U.K.), and Hideaki Maemoku (Japan), which appeared to suggest that the river had largely dried up long before Harappan times.

Lawler’s verdict was hasty as well as inaccurate. Two years earlier, Clift had noted that ‘between 2000 and 3000 BCE, flow along a presently driedup course known as the Ghaggar-Hakra River ceased, probably driven by the weakening monsoon and possibly also because of headwater capture into the adjacent Yamuna and Sutlej Rivers’ (Clift, 2009). Then, in 2012, Clift’s multi-national team dated zircon sand grains from trenches and drilled cores at four sites in Cholistan (the U-Pb dating method they used is a standard one that measures variations in the ratios of isotopes of uranium and lead to date the formation of rocks over millions or even billions of years). By comparing the zircon grains with those from other regions, the geologists concluded that the Yamuna once flowed into the Ghaggar-Hakra, as had often been suggested since the late

nineteenth century, but switched eastward tens of thousands of years ago; the Sutlej also contributed to the Ghaggar system but abandoned it 10,000 years ago or earlier. As a result, any drainage capture affecting the Ghaggar system ‘appears to have occurred prior to human settlement and not to have directly caused the Harappan collapse’ (Clift et al., 2012). Being limited to samples from Cholistan, the paper had to remain non-committal about the time when the Ghaggar itself dried up.

The same year, a study by a team of geoscientists under the direction of Liviu Giosan (with most of its members drawn from the previous study’s team) reached slightly more precise conclusions. It rejected the possibility that ‘large glacier-fed Himalayan river watered the Harappan heartland on the interfluvium between the Indus and Ganges basins’; rather, in its view, ‘only monsoonal-fed rivers were active there during the Holocene’ (that is, the last 10,000 years or so). In particular, ‘rivers were undoubtedly active in this region during the Urban Harappan Phase’. Indeed, the geoscientists found ‘sandy fluvial deposits approximately 5,400 [years] old at Fort Abbas in Pakistan [in Cholistan], and recent work on the upper Ghaggar-Hakra interfluvium in India also documented Holocene channel sands that are approximately 4,300 [years] old.’ (Giosan et al., 2012) In a later comment on the paper, Giosan clarified, ‘Our research points to a perennial monsoonal-fed Sarasvati river system with benign floods along its course’ (Giosan et al., 2013). The Ghaggar-Hakra was thus active during the urban Harappan period, although apparently not (or no longer) fed by glacial sources; it was a monsoon-fed river, like rivers of central or southern India: ‘Reliable monsoon rains were able to sustain perennial rivers earlier during the Holocene, [which] explains why Harappan settlements flourished along the entire Ghaggar-Hakra system without access to a glacier-fed river’ (Giosan et al., 2012).

The last point remains an object of debate among geologists, with several Indian ones maintaining that the Ghaggar system did have contributions from Himalayan glaciers (Puri & Varma, 1998; Valdiya, 2002, 2013; Puri, 2001, 2008). We must leave it to them—or, more likely, to the accumulation of new data—to settle the issue. What matters, for the moment, is the acknowledgement of a perennial Ghaggar’s role in sustaining numerous Harappan urban settlements, and the coincidence between its dwindling down and the withdrawal of Harappan sites from its central basin.

This is further supported by a 2009 study by H.S. Saini et al., which studied buried channels in the northwestern Haryana Plains and documented ‘the existence of channel activity during the mid-Holocene ... in a part of the Haryana plains’; by mid-Holocene is meant a ‘second fluvial phase ... represented by a palaeochannel segment [Fig. 9] whose signatures are dated between ~ 6.0 and ~ 2.9 Ka’ (Saini et al., 2009), after which a depleted Ghaggar was left. The dates bracket the Indus civilization.

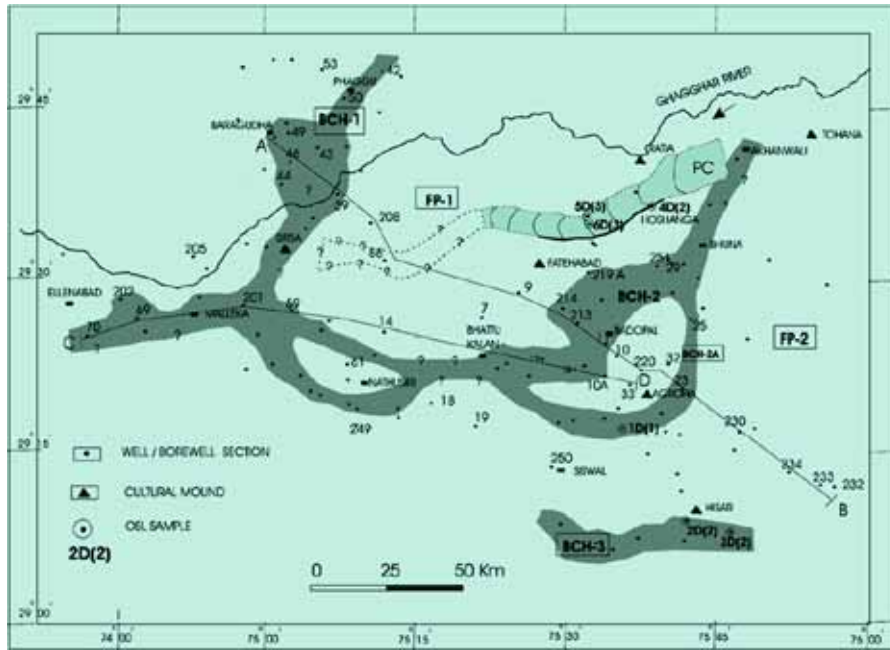


Fig. 9. Buried channel systems in Haryana (courtesy Saini et al., 2009).

Finally, a 2013 study directed by the Indian geologist Rajiv Sinha, which mapped palaeo-river sedimentary bodies in the subsurface by measuring their electrical resistivity, since water-bearing sediments having a lower resistivity than dry ones (Fig. 10). The study offered ‘the first stratigraphic evidence that a palaeochannel exists in the sub-surface alluvium in the Ghaggar valley. The fact that the major urban sites of Kalibangan and Kunal lie adjacent to the newly discovered subsurface fluvial channel body ... suggests that there may be a spatial relationship between the Ghaggar-Hakra palaeochannel and Harappan site distribution’ (Sinha et al., 2013).

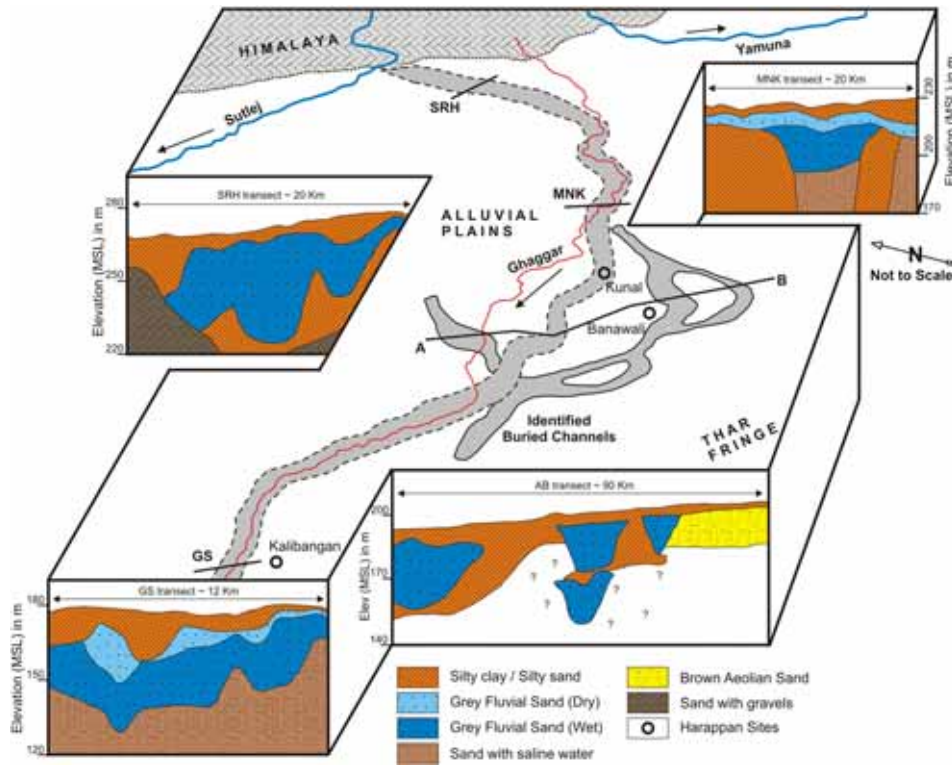


Fig. 10. Sub-surface stratigraphy of the Ghaggar basin (courtesy Sinha et al., 2013).

Such a conclusion had been reached by archaeologists much earlier, since Kalibangan, for instance (Fig. 11), shows no evidence of independent water supply; unlike Mohenjo-daro, it had very few wells, and unlike Dholavira, no reservoirs, yet it was continually occupied for several centuries: for its water supply through the year, it must therefore have depended on the Sarasvati, on whose left bank it lay, with entries into its fortified enclosures facing the riverbed. Banawali and Bhirrana, too, were built right on the river's bank (Fig. 11). Why should the technology-savvy Harappans have taken so much trouble to build cities right on the edge of dried-up rivers?

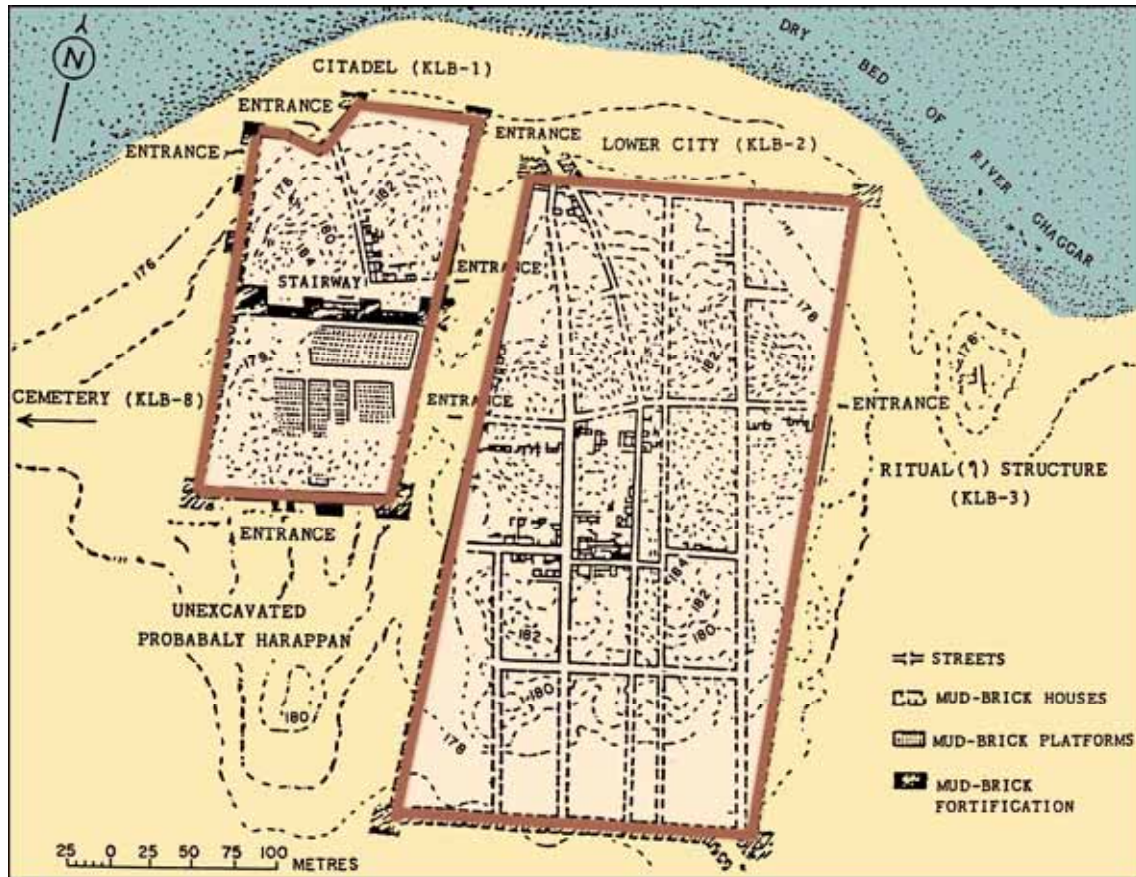


Fig. 11. Plan of Kalibangan (adapted from Archaeological Survey of India).

In fact, noticing a break in the settlement pattern in Cholistan, close to the international border (visible on Fig. 8 above, central portion), M. Rafique Mughal suggested in 1993 that the river, which was ‘a perennial river through all its course in Bahawalpur during the fourth millennium B.C. (Hakra Period) and the early third millennium B.C. (Early Harappan Period)’ (Mughal, 1993: 94), lost a channel from the Sutlej in the west and, in the east, the Chautang (or Drishadvati) to the Yamuna system. This, in his estimate, happened between the Early and Mature phases, that is, around 2600 BCE.

Archaeology and geological studies thus appear to converge in depicting an already depleted Ghaggar or Sarasvati during the Mature Harappan phase. Besides, palaeoclimatic studies have in recent years pointed to a weakening of the Indian summer monsoon from 2200 BCE onward (for a survey, see Danino, 2015). It seems clear that the long drought that followed contributed to the final break-up of the

Sarasvati, although other causes such as river dynamics and tectonics cannot, at this stage, be ruled out.

As regards the ‘controversy’ surrounding the Vedic river, allowing for some metaphorical inflation in the Vedic hymns, nothing in the recent research contradicts the river’s break-up and gradual extinction as recorded in India’s ancient literature. We are thus back to the original problem: If we accept the Vedic hymns’ description of a river flowing from the mountain to the sea and located between the Yamuna and the Sutlej, the Ghaggar remains the sole candidate; but as we now know, this description can only apply to the 3rd millennium BCE or earlier, an epoch that does not fit with the conventional scenario of a 2nd-millennium Aryan migration into India. When this issue is finally resolved, India’s protohistory will perhaps be upgraded to history.

From Sarasvati to Ganga

In the meantime, two lessons flow from the river’s disappearance. The first is that it forced migrations of Harappans in several directions, in particular eastward, crossing Ganga and mingling with agrarian communities long established in the Gangetic plains. The Late Harappans, as they are called, reverted to rural lifestyles but carried some of their culture with them, which explains the transmission of a host Harappan cultural features, symbols, practices and technologies to the later Ganga-Vindhya civilization. Besides, Indological studies have shown that the sacredness of the Sarasvati and her attributes as a goddess were transmitted to Ganga in the course of centuries.

Secondly, it is now clear that climatic and environmental disruptions played a major part in the break-up of the Indus civilization. No one can deny anymore that we are now undergoing another major climatic change; a just published study predicts that at least 70 per cent of the volume of Himalayan glaciers in the Everest region may disappear by the end of this century. With human interference (deforestation, excessive damming, etc.) compounding the problem, there have been warnings that Ganga and the Brahmaputra may turn into seasonal rivers even before. This may spell the end of the 3,000-year-old Ganges civilization in its mother-region. We must hope that mitigating steps will be urgently taken to save Ganga from becoming another Sarasvati. The Late Harappans had some time and plenty of space to relocate, fall back on rural lifestyles

and adapt themselves to new situations; if Ganga and the Brahmaputra disappear, we may have neither. How will the tens of millions dependent on the Gangetic system survive when Prayag's *triveni sangam* consists of three invisible, 'mythical' rivers?

Born in France in 1956, Michel Danino has been living in India in 1977 and is an Indian citizen. An independent student of Indian civilization, he has lectured widely at higher educational institutions, and authored papers and books in French and English. Recent titles are *The Lost River: On the Trail of the Sarasvati* (Penguin India, 2010), *Indian Culture and India's Future* (DK Printworld, 2011) and *The Dawn of Indian Civilization and the Elusive Aryans* (forthcoming). Since 2011, Michel Danino has been guest professor at IIT Gandhinagar, where he is assisting the setting up of an Archaeological Sciences Centre. Email: micheldanino@gmail.com.

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